

# **OPTION A: ANALYTICAL CHEM**

## **A10 – HL FURTHER CHROMATOGRAPHY**

IB Chemistry

TAD08



# A10 – HL – Further Chromatography

- A.10.1 Describe the techniques of gas–liquid chromatography (GLC) and high performance liquid chromatography (HPLC). (2)
  - *An outline of the operation for each technique will be assessed. This should include an understanding of  $R_t$  value and its dependence on other factors where relevant.*
- A.10.2 Deduce which chromatographic technique is most appropriate for separating the components in a particular mixture. (3)
  - ***Aim 8:** HPLC can identify compounds that are temperature-sensitive. Uses include: analysis of oil; alcoholic beverages; antioxidants, sugars and vitamins in foods; pharmaceuticals; polymers; biochemical and biotechnology research; and quality control of insecticides and herbicides. GLC can identify compounds that can vaporize without decomposing. Uses include: analysis of urine samples from athletes for drugs, underground mine gases and blood alcohol levels.*



# GLC & HPLC Techniques

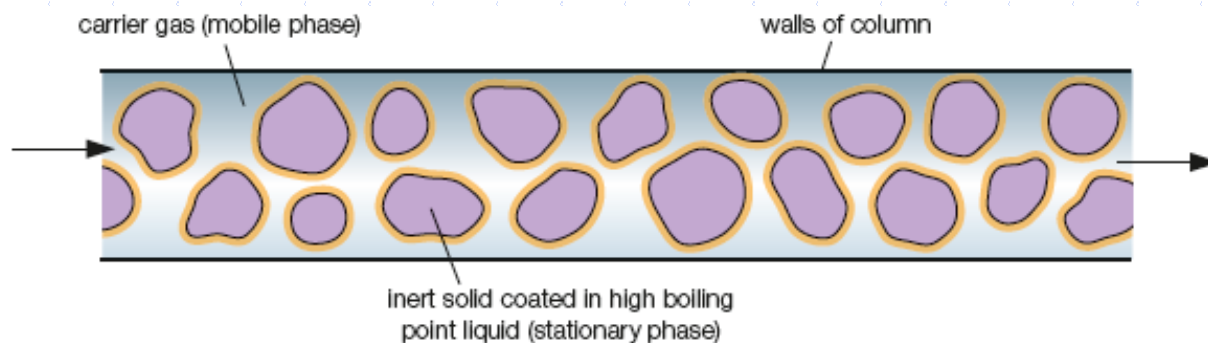
A.10.1 Describe the techniques of gas-liquid chromatography (GLC) and high performance liquid chromatography (HPLC). (2)

- GLC (Gas-Liquid Chromatography)
  - Used to separate and identify very small samples of gases, liquids, and volatile solids
  - Uses: testing for steroids in urine samples, testing Formula One fuels to confirm additives are within the limits
- HPLC (High-Performance Liquid Chromatography)
  - Used to separate small samples of non-volatile substances and determine the amount of each component present in the mixture
  - Can measure temperature sensitive compounds which GLC cannot
  - Uses: Analysis of oil, alcoholic beverages, antioxidants, sugars, vitamins, etc



# GLC - Phases

- Stationary Phase: non-volatile liquid kept at a controlled temperature in an oven
  - Often absorbed onto the surface of a solid material contained in a long narrow and coiled tube or column
  - Consists of a long-chain alkane (with high B.P.) coated on the surface of silica ( $\text{SiO}_2$ )
- Mobile Phase: an inert carrier gas (dry  $\text{N}_2$  or Ar) passed through the column at a constant measured rate
  - Unwanted organic solvents can be removed by passing the gas through activated charcoal.



**Figure 21.141** Inside a GLC column (usually coiled so it fits into the oven)



# GLC – Sample Treatment

- Treatment of sample:

- Injection: with microsyringe
- Vaporization: prior to column
- Separation:

- More volatile compounds (low BP and often gases) travel more quickly and reach the detector first
- The time for the component to travel through the column is known as **retention time**
- The **retention time** for a component (at given temperatures, etc) is fixed.
- If working with components with high BP, the system can be heated up to speed up travel through the column and hence different retention times are used.

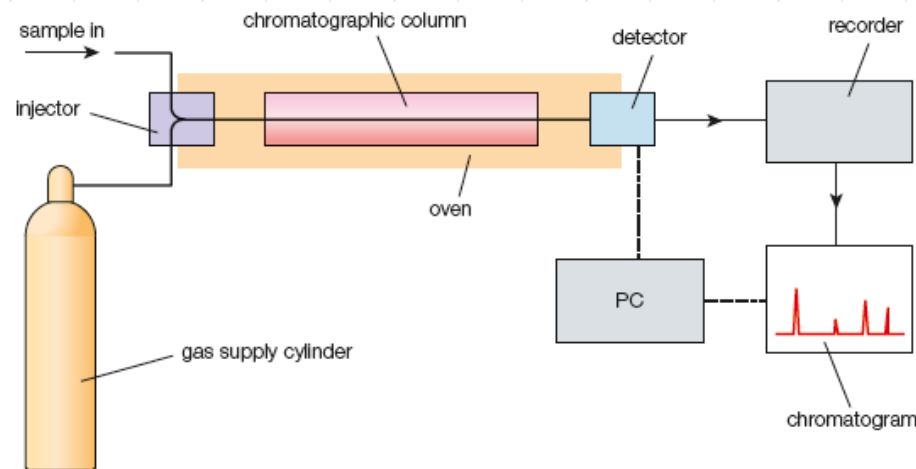
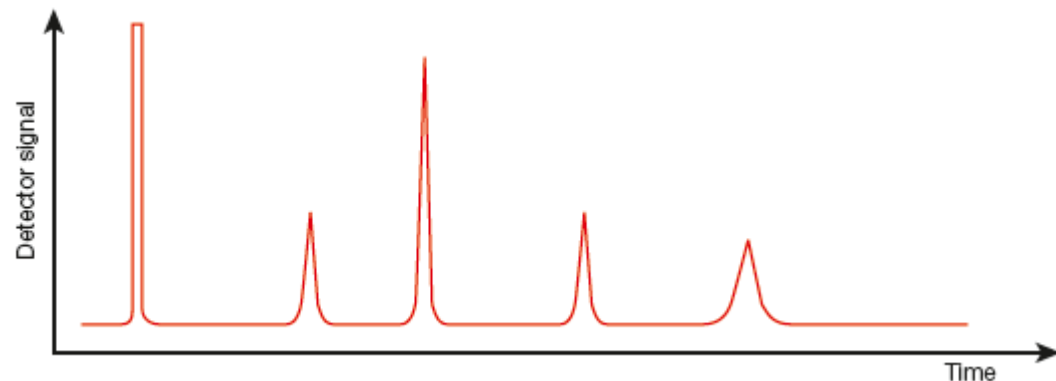
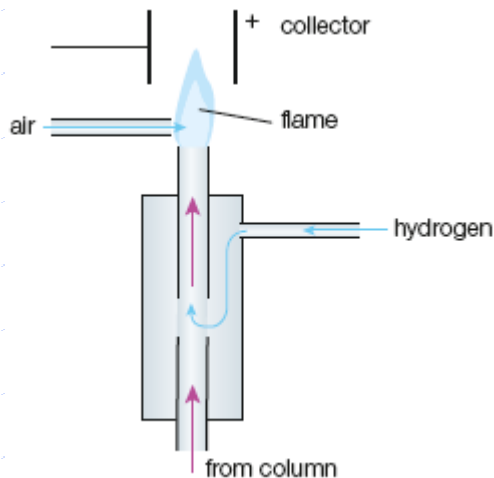


Figure 21.142 The main components of gas-liquid chromatography



# GLC Detector and Data

- Flame Ionization Detector:
  - Sample leaving system is burnt in  $H_2$  flame to produce ions and interact between two plates carrying electric current.
  - The change in current is used to produce a response converted into an electrical signal.

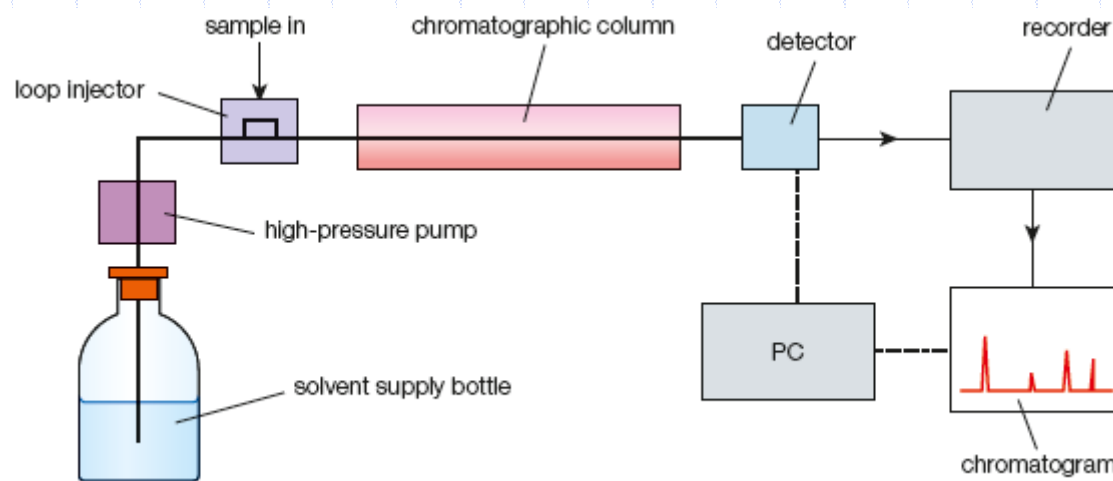


**Figure 21.143** A GLC chromatogram: plot of peak of height against retention time



# HPLC

- HPLC is similar to GLC but the mobile phase is different:
  - Mobile Phase: solvent or mixture of solvents (compare to GLC gas)
    - The mobile phase in HPLC (unlike GLC) controls the retention times
  - Stationary Phase: particle size is significantly decreased (compared to traditional column chromatography) which results in a higher efficiency and resolution
    - A high pressure pump is then needed to force liquid through a mass of tiny particles. Otherwise the flow rates would be far too slow.
  - Components often detected via UV radiation at the end of the column





# Finding the proper method

A.10.2 Deduce which chromatographic technique is most appropriate for separating the components in a particular mixture. (3)

- GLC (Gas-Liquid Chromatography)

- Used to separate and identify very small samples of gases, liquids, and volatile solids
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